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agencies whereby this food will be replaced when that which is now present is consumed. We must also recall that water, air and temperature greatly influence the bacterial content of the soil and they are probably more sensitive to changes in respect to these three requirements than are the plants themselves. As will be seen later, it is possible to meet all the demands of the physicist and yet have an unproductive soil.

The single standpoint of the chemist is also open to criticism, for, granting that the right amounts of the necessary elements are present in the soil and are in an available form at the time of examination, they will soon become exhausted unless replaced by bacterial activity. The amount and kind of material in the soil solution is one that has caused considerable discussion and for which we can set no arbitrary standards, knowing that this is intimately related to the composition of the soil, which is dependent upon the original nature of the rock of this place and the care of the land since it has been cultivated. Would it, remembering that different animals require different kinds and amounts of foods to repair their protoplasms, be quite correct to assume that all plants require exactly the same amounts of various substances to repair their equally diversified protoplasms?

While it may be claimed that the bacteriological content of a soil is a very delicate index of its fertility, we must not forget that the chemistry and physics of the soil are also important. It is true that from the type of bacteria present we can form a good idea of the fertility of the soil, but without the knowledge gained from a physical and chemical examination we have no means of knowing how long these conditions will persist.

The problem of soil fertility then is a composite one which needs for its solution a knowledge of the interrelated subjects physics, chemistry and bacteriology. With these points in view, it becomes a very simple matter to harmonize statements which on the surface seem conflicting. We now know that it is necessary to provide the proper laboratory (physical conditions) and the necessary raw material (chemi-

icals, etc.) in order that the particular bacterial cell which we desire may do its work in increasing the fertility of the soil. In order to show the dependence of the bacterial cell on physical factors, we may cite the physicist's demand for a porous soil and remember at the same time that the organisms beneficial to plant life require oxygen in order to continue their reactions. Again the necessity for moisture is clear when we remember that bacteria can use only food that is in solution, and the question of a proper temperature is explained when we remember that at the optimum temperature of the bacteria in question, their reactions are greatly accelerated.

To discuss in detail the tenets of the chemist would require too much space here, but one simple illustration may suffice to show the close relationship between the chemical composition of a soil and its bacteriological content. The adding of chemicals to a soil affects the physical and bacteriological nature of the soil as well as the chemical content. When we remember that the activity of bacteria often produces acid end-products, which if not neutralized will inhibit their activity and finally cause their death, the reason for the addition of lime to a soil is easily understood.

If we provide all the conditions above outlined and the soil continues to be unfertile, we may be sure that we have not the proper bacteria present or else some enemy such as certain protozoa are present and are preying on those bacteria which make plant life possible upon the earth. As animals are in the last analysis dependent upon the plants for food, and as plants are dependent upon the nitrifying bacteria, we can easily see that no life could long exist upon the earth without the aid of these organisms.

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THE THIRTEENTH NEW ENGLAND INTER-COLLEGIATE GEOLOGICAL EXCURSION

THE annual meeting of the Geologists and Geographers of the New England Colleges and Universities was held under the direction of

Professor Joseph Barrell, of Yale University, on Friday and Saturday, October 15-16.

The purpose of the excursion was to determine whether or not the so-called Cretaceous peneplain of southern New England was the work of subaerial or of marine erosion, and was conducted by the author of the latter theory.

In the preliminary lecture delivered in Peabody Museum, Yale University, Professor Barrell pointed out that the importance of peneplanation in continental interiors was not questioned nor the quantitative dominance of river erosion even on the eastern side of the Appalachians. From evidence based on a broad study of the country between Vermont and Virginia it was concluded that the so-called peneplain of southern New England was originally stair-like or terraced in its character, the terraces facing the sea and bearing the marks of having been developed by recurrent marine denudation. By projecting the base of the Potomac and later formations their relations were brought out with the marine terraces of Maryland. The oldest terrace is regarded as Upper Cretaceous. The Piedmont plateau is regarded as developed by alternations of marine and subaerial denudation during the Pliocene.

The party left New Haven Saturday at 8:00 o'clock for Waterbury, Conn., where automobiles awaited. The route traversed extended through Morris, Litchfield and Goshen to Torrington. Luncheon was eaten in Litchfield.

The four terraces recognized in this region by the leader, regarded as Pliocene in age, and pointed out to the party are:

Cornwall terrace, elevation 1,680-1,720,
Goshen terrace, elevation 1,340-1,380,
Litchfield terrace, elevation 1,100-1,140,
Prospect terrace, elevation 880-920.

Of these terraces the Prospect in the locality viewed was seen to have been much dissected by subaerial erosion while the Litchfield has a remarkably smooth surface. No line of cliffs separates these two terraces, the separation being determined largely from topographic maps by the rather rapid descent of the surface near the junction of the two terraces.

Rather pronounced but much dissected scarps between the Litchfield and Goshen and between the Goshen and Cornwall terraces were pointed out.

It was suggested by members of the party that the terraces might have been caused either, (1) by monoclinal warping or, (2) by a difference in the hardness of the rock. It was pointed out by one of the physiographers, however, that mere difference in hardness of rock would hardly account for the succession of dissected levels which was observed. The leader regarded monoclinal warping as inapplicable when applied to the actual details as developed across the country.

In general, Professor Barrell holds that the highest or Cornwall terrace was first cut by the marine erosion of a region of slight relief. The region was then raised, perhaps 400 or 500 feet, the sea retreated, subaerial denudation etched out the land surface, then moderate submergence took place to a level about 340 feet below the Cornwall level and the second or Goshen terrace was planed. Another oscillation resulting in a final elevation of 240 feet more permitted the sea to cut the Litchfield terrace. The Prospect terrace was cut when the region was raised about 220 feet further and perhaps after a prolonged stage of subaerial denudation. Lower and younger levels were cut by the waves on the seaward slopes before the sea reached its present position with reference to the land, each phase being represented by subaerial denudation farther inland. The sediment which had been spread over the sea bottom as the land was cut away to form the terraces has been removed by the streams since the successive terraces were subjected to subaerial erosion.

Twelve colleges and universities were represented by the fifty-two persons who were on the excursion.

The beauty of the autumnal coloring and of the region traversed added pleasure to one of the most interesting and largely attended of these annual excursions.

H. F. CLELAND,
Secretary